Soldier Focused Logistics

"Transforming the Chinook"

A Team Redstone Initiative

The State of Aviation Maintenance

- Continuously Increasing System Complexity.
- Cumbersome Update Process for Tech Data.
- Lack of “At the Aircraft” Information (field data).
  - Existing data collected “on the backs of the soldiers”
- Increasing Maintenance Burden (Aging Aircraft).
- Scheduled Maintenance Creep.
- Continuous Pressure to Downsize Support Structure.
- Corporate Memory erosion (expertise).
  - FHP, Retention, Development, Retirement
- Training Dependent on OJT in Reduced FH Environment.

Transforming the Chinook- the Vision

To provide best-in-class weapon system support that off-loads the Soldier, meets the logistics transformation goals, and affords the warfighter an unprecedented capability to manage their combat systems and accurately predict a true "Go-to-War" capability.

A major tenet of this effort is continuous evaluation and improvement, focused on the soldier. The three top priorities of this transformation are:

- *Reduce the burden on the soldier*
- *Reduce the burden on the soldier*
- *Reduce the burden on the soldier*

OSD VE Pilot

CH-47F

RCM2

AMAC

714A Engine

912(c) Pilot

DAU Log 206 Model

Extended 400 hr Phase

Engine Testability

Recapitalization

SFL

OSD UID Pilot

DLA SSA Pilot

OSD JDSR Pilot

The Starting Place - The Aircraft

- All Costs Start at the Aircraft.
- Total Cost is $\Sigma(M_E \bullet C_{ME})$.
- Total Downtime = $\Sigma(M_E \bullet DT_{ME})$.
- Real improvement occurs only when M_E , C_{ME} or DT_{ME} are reduced and are measurable.

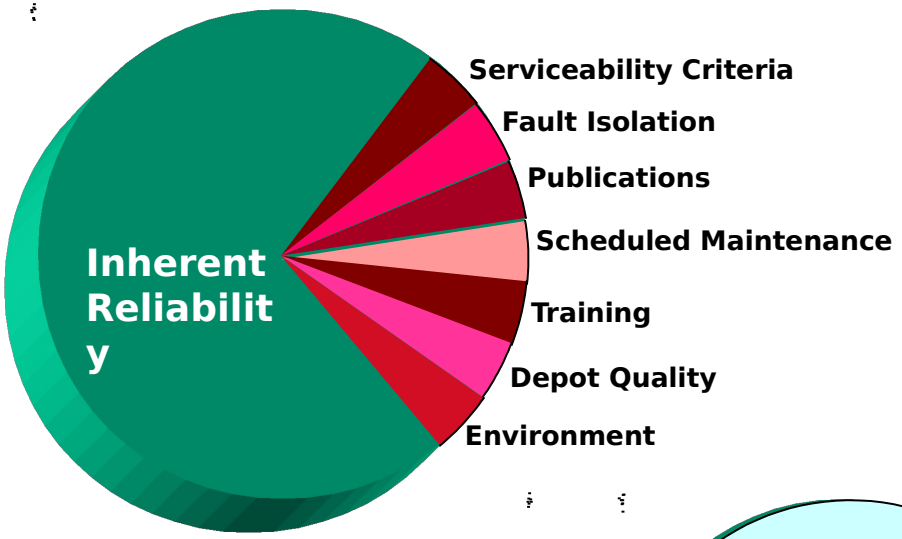
Definitions:

M_E - Maintenance Event.

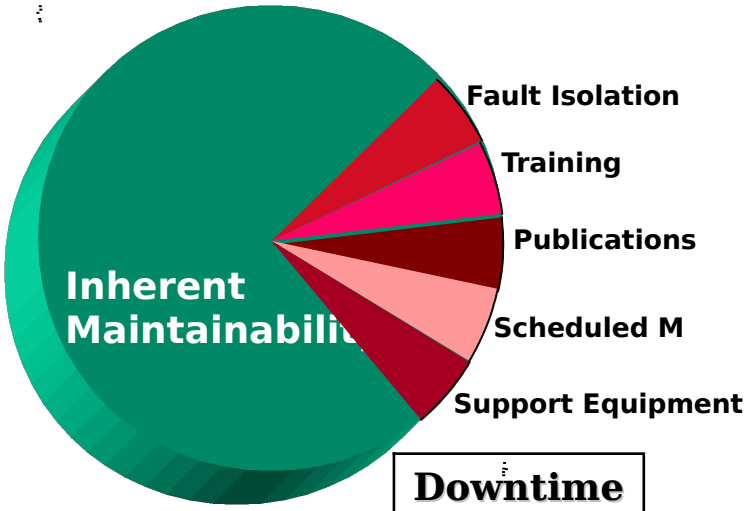
C_{ME} - Cost Per Maintenance Event.

DT_{ME} - Downtime per Maintenance Event.

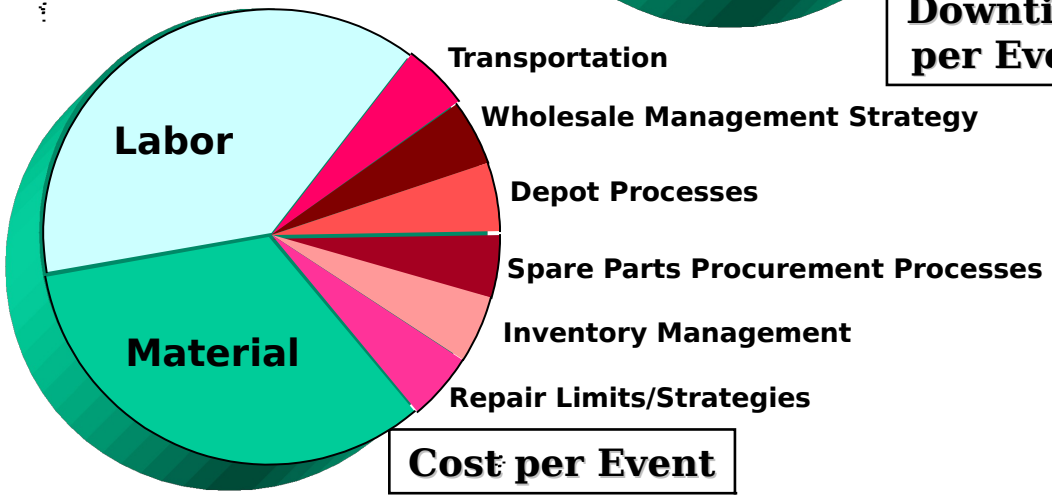
What Drives Cost and Downtime?



Maintenance Event Frequency



Downtime per Event



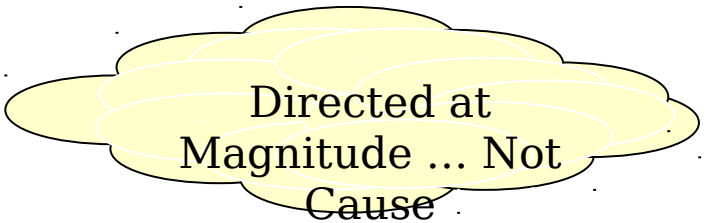
Cost per Event

Non Hardware issues are just as important as Hardware issues

The Challenge...

Understanding Component Level Contributions to System Support Costs and Readiness

- **No Current Data System Gives Insight Below Top Level f**
  - **Cost ... OSMIS**
  - **Readiness ... 1352**

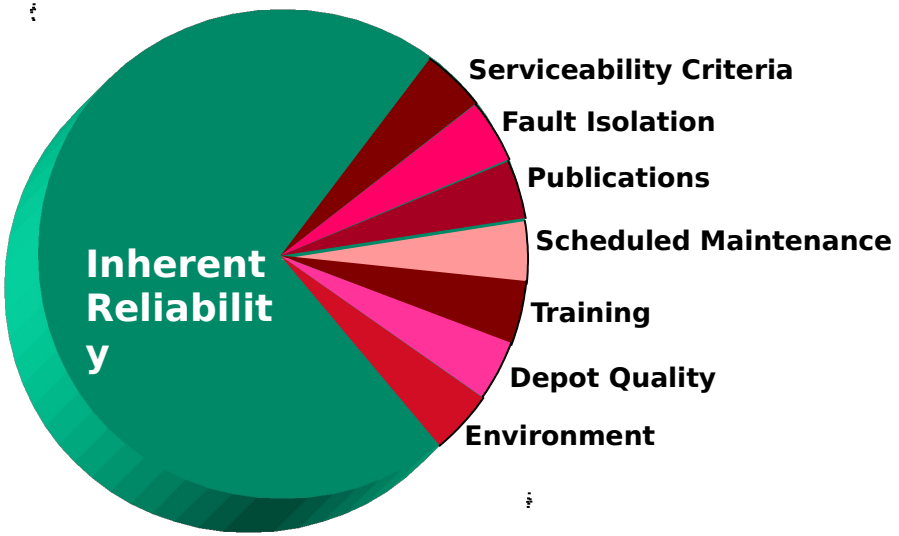


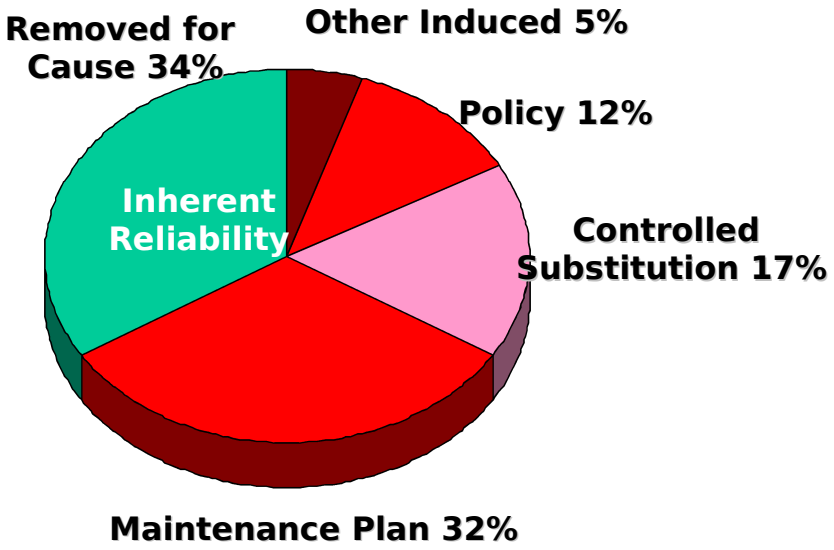
- **Lack of 2nd Level of Detail Results in Suboptimization o**
  - **Maintenance Support Strategies.**
  - **Ill-Conceived O&S Cost Reduction Initiative.**
  - **Inefficient Wholesale Logistics Practices.**
  - **Inability to Establish Total Life Cycle Management Per**

We Have to "Manage With the Force of Facts*"

*Bill Gates, Business @ The Speed of Thought" 1999

What Causes Aviation O & S Costs



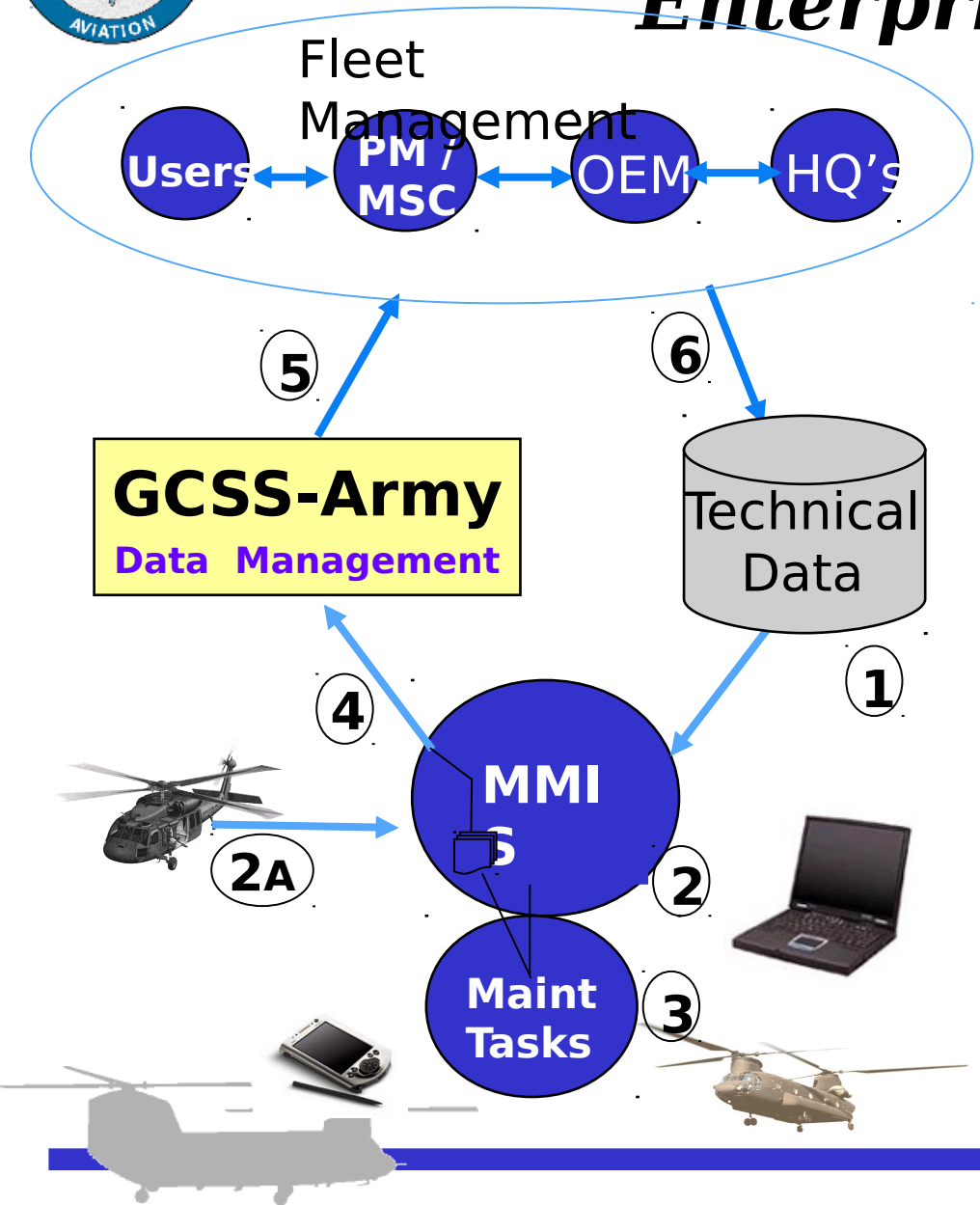


Maintenance Event Frequency

Removal for Cause: Operational Malfunction/Failure.
Maintenance Plan: Scheduled Removal, Time Change, Retirement.
Controlled Substitution.
Policy: MWO, SOF, ASAM, Removal per DMWR.
Other Induced: ~~Mission or Environment~~ Induced.

Aggregate of all 2410 Components

How does AMAC Operate w/in Enterprise?



Closed-Loop System

Step 1 - Technical Data is maintained in a central database. Changes are transmitted to the MMIS at the user location.

Step 2 - The MMIS assembles technical data in card format or interfaces with an IETM.

Step 2A – On-Board system provides Health and Usage Data to MMIS.

Step 3 - Maintainer performs maintenance and "documents" via electronic card or IETM through MMIS.

Step 4 - The MMIS provides local management capabilities and sends field data to GCSS-Army.

Step 5 - **Fleet Management**: Data is accessed and analysed, by PM, User, Higher headquarters, OEM and other stakeholders.

Step 6 – Two way communication permits feedback from fleet level.

Task Frameset - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://localhost/ecard/ecard/taskframe.asp?intMWO=&intPartScreen=&intASN=&strParentTaskID=&strArisingTaskID=&strTaskID=AAARO7AAHAAAL1LAAO&intStepNumber=1&intSelStart=20&intSelEnd=60&st
Links

CH47 E-CARD PROTOTYPE

STATUS | TASK LOCATION | AIRCRAFT TAILNUMBER | ASN / ARISING CODE

SELECTED TASK

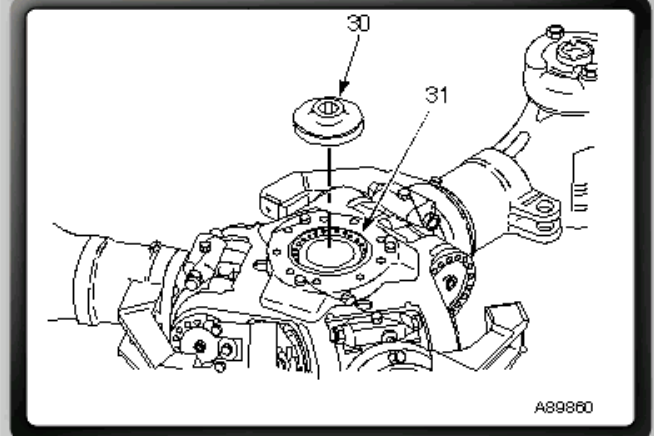
Remove Fwd Rotary-wing Head

FIRST 20 LAST 60 GO SIGN COUNTERSIGN ENLARGE

TASK STEPS

STEP	CHECK	TRAINING	DESCRIPTION
22	☐		Position socket (T29) (30) on hub retaining nut (31).
23	☐		NOTE For forward head, install adapter with marking FWD ROTOR THIS SIDE UP on top. For aft head, install adapter with marking AFT ROTOR THIS SIDE UP on top. Install reaction adapter (T28) (32) as follows.
24	☐		Secure three reaction hooks (33) to adapter (32), with REMOVAL side out. Use bolts (34).
25	☐		Position adapter (T28) (32) on top of head (1) with reaction hooks (33) against caps (35) and with handwheels (36) on top.
26	☐		CAUTION Do not over-tighten handwheels; otherwise, damage to rotor hub or adapter can occur. Position three clamps (37) under top flange (37.1) of head (1). Tighten handwheels (36).
27	☐		Install torque applicator (T2) (38) and tee handle (T161) (39) on reaction adapter (T28) (32). Turn handle, if required, to rotate applicator to engage reaction pins (39.1) in adapter.
28	☐		CAUTION Do not use power tools to turn torque applicator. Applicator could be severely damaged. NOTE Pins under torque applicator must be fully seated in reaction adapter (T28) to prevent applicator ride-up when torque is first applied. Turn handle (39) counterclockwise until nut (31) is loose.
29	☐		Continue to loosen nut (31) until torque drops to near 0 foot-

Step 22 Image 1 of 1



ENLARGE

TASK SUMMARY | MAKE A COMMENT | COMPLETE TASK | RECORD ASSOCIATED FAULT

Done
Local intranet

Cargo LCM Process

CH-47 Life Cycle Management

Fleet Metrics

Info Center

Baseline

Enterprise Data

Fleet Model, Metrics & Problem Reports

AMAC

Performance Data

"The System"

Helicopter, Processes & Organization

Projected/ Demonstrated Performance

Directed Insight

TRADOC

MACOM

Improvement Teams

RDEC

PEO/IMMC

Analyses

Process & Hardware Projects

Project Teams

Fleet Improvements

Soldier Focused Logistics

Phase 1 – Process Re-Engineering

- Build on CH-47 Life Cycle Management Concepts.
- Re-engineer LCM processess…
  - From <u>historical</u> “Readiness” – Static, based on historical averages
  - To <u>predictive</u> “GO-to-WAR” – Sustained capability from future projections
- Drive Process Change Through Shared Metrics.
- Meet DA/OSD Goals (Readiness/TOC).
- Applicable to Entire Weapon System.

The Problem:

GOALS: Ao ≥ 90%
TOCR ≥ 20%

DA

AMC/DLA	TRADOC	ASAALT	Field MACOM
Supply Availability	Percent Seat Load Trained	Cost / Schedule / Performance	Current Readiness Reporting Procedures

WHAT'S WRONG ? – METRICS!

The Solution: Shared Metrics

DA

- Go to War Capability
- SRS

AMC/DLA

- Supply Chain Management
- Customer Wait Time for Essential Items
- AOG

TRADOC

- Percent Seat Load Trained
- Mechanic Proficiency

ASAALT

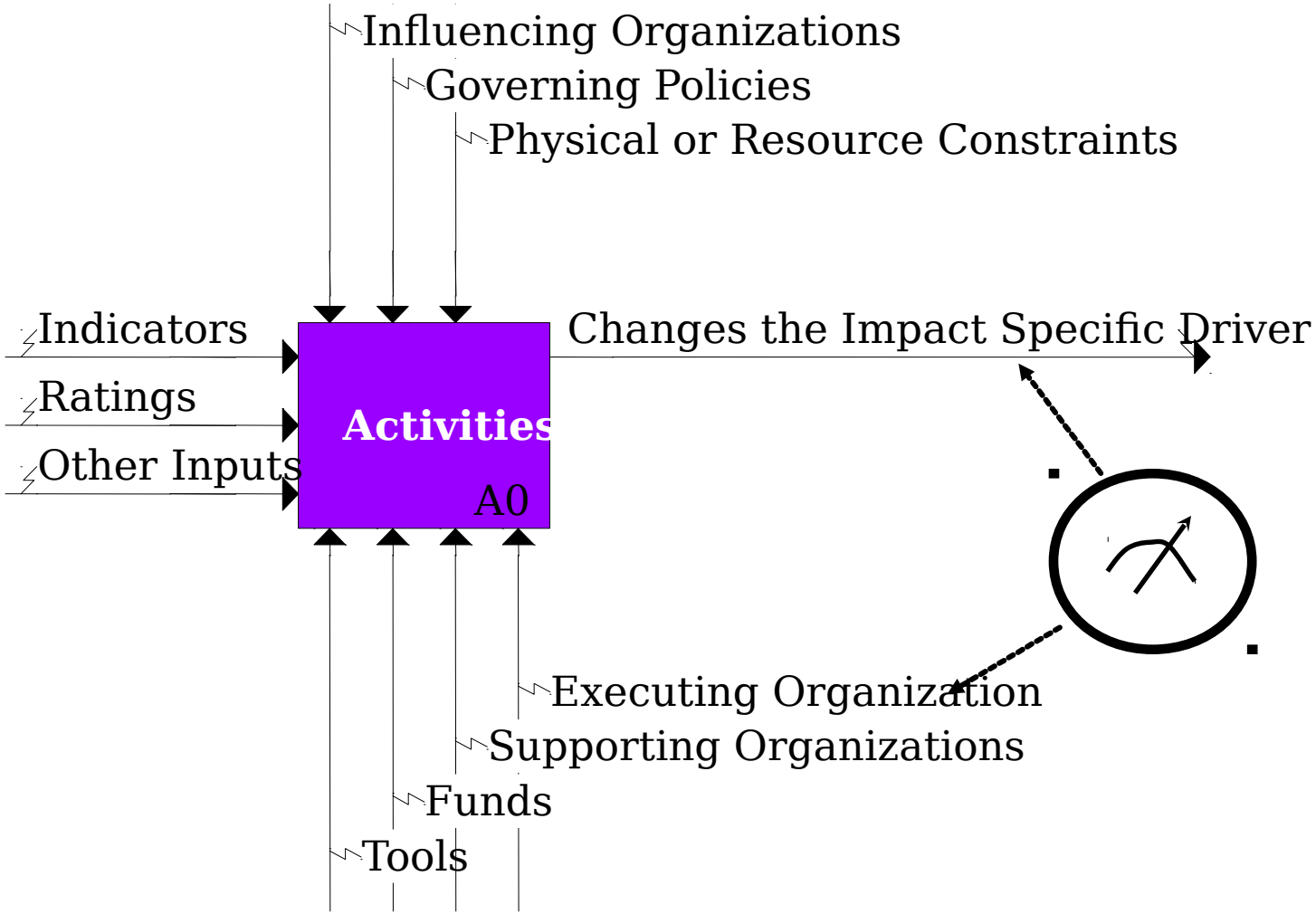
- System Performance
- Cost / Schedule / Supportability

Field MACOM

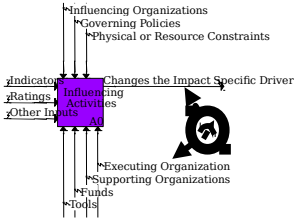
- Readiness Sustainment Reporting (Go To War Capability)
- Manpower Utilization

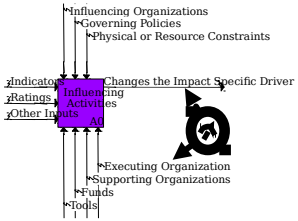
GOALS: **Ao ≥ 90%**
TOCR ≥ 20%

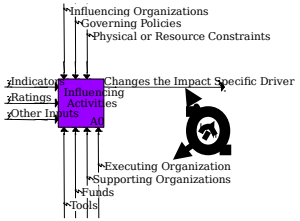
SFL Activity & Process Metrics

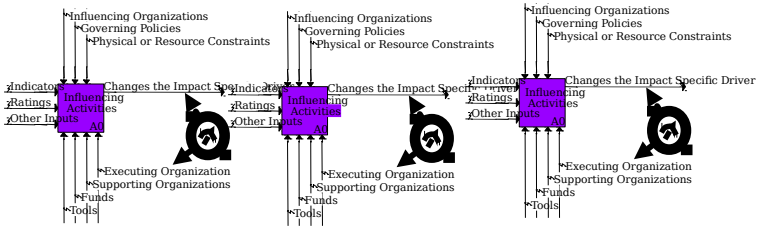


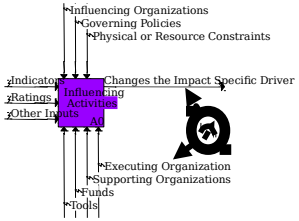
SFL Activity & Process Metrics

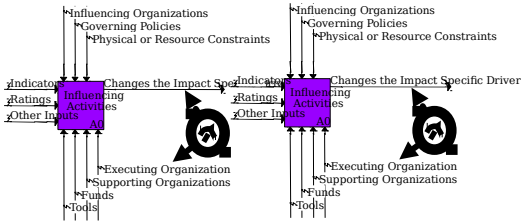


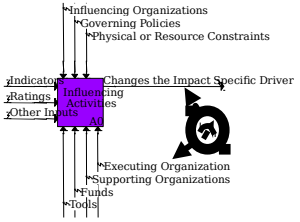






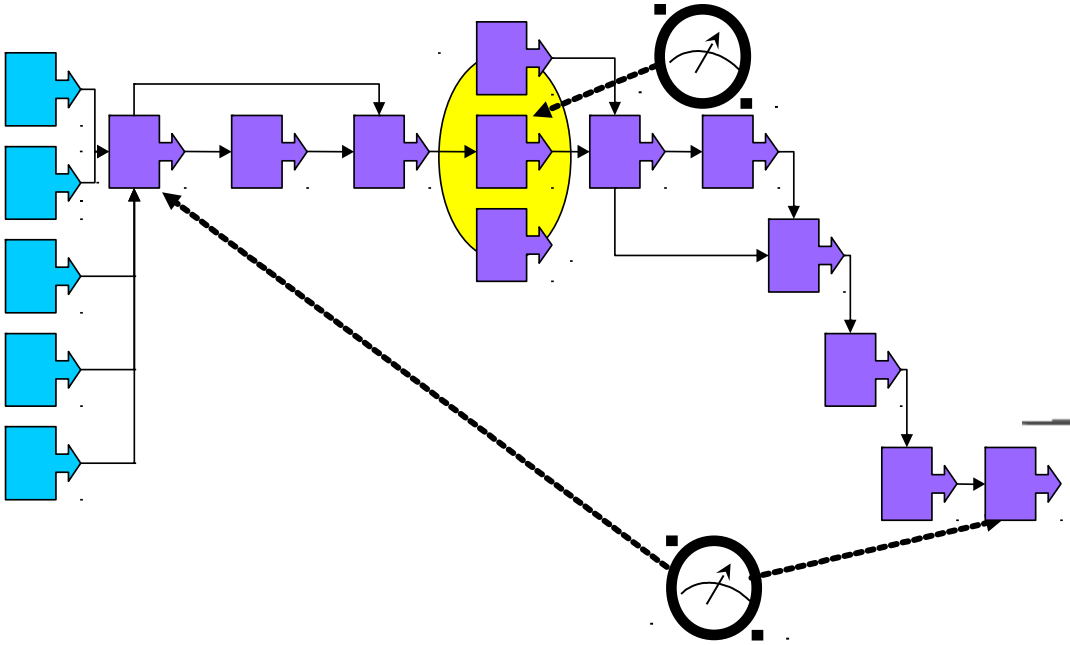




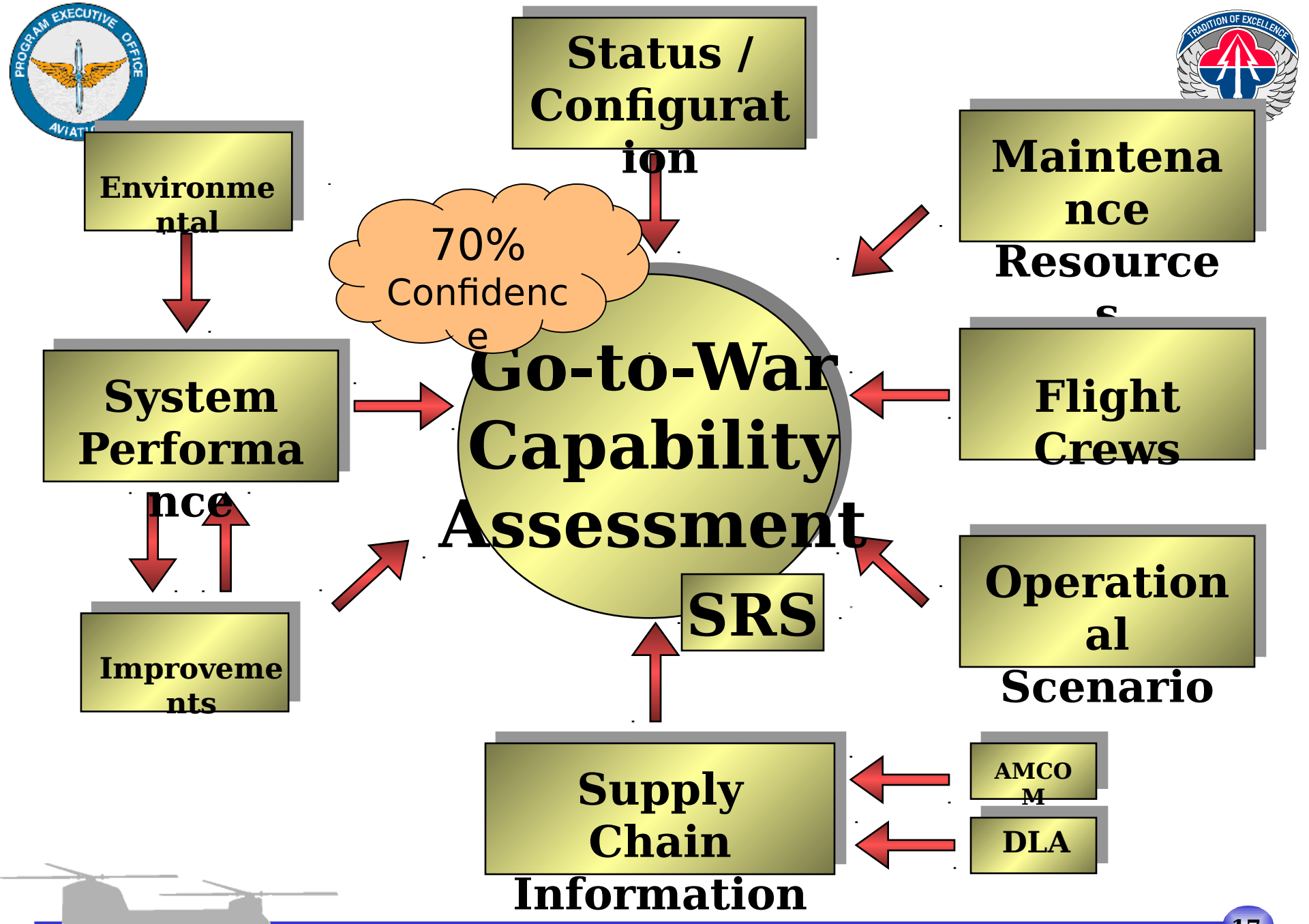


SFL Activity & Process Metrics

Process Metrics Drive Performance of the Sustainment System



- Early Identification of Problems
- Information for Decision Makers
- Provide Individuals what is needed for the success of the Team


Status / Configuration
Environmental
Maintenance
Resources
70% Confidence
Go-to-War Capability Assessment
System Performance
Flight Crews
Improvements
SRS
Operational Scenario
Supply Chain
AMCOM
DLA
Information

Six Patterns of Failure

Bath Tub curve

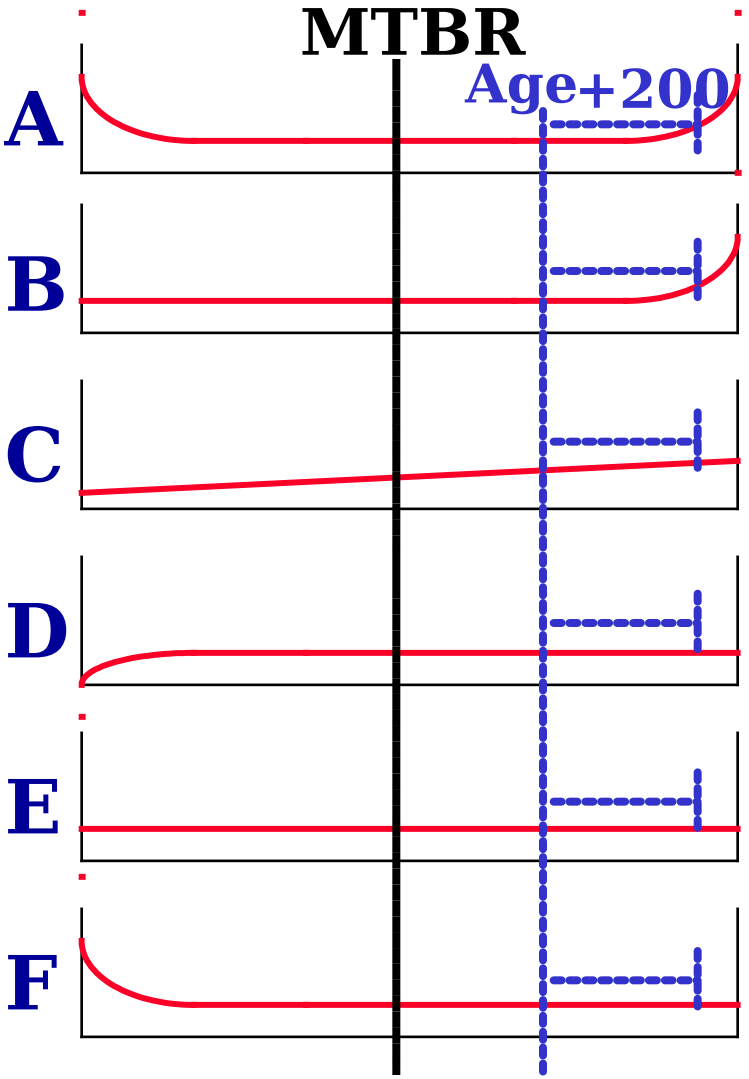
Slowly increasing failure rate, then wear out zone

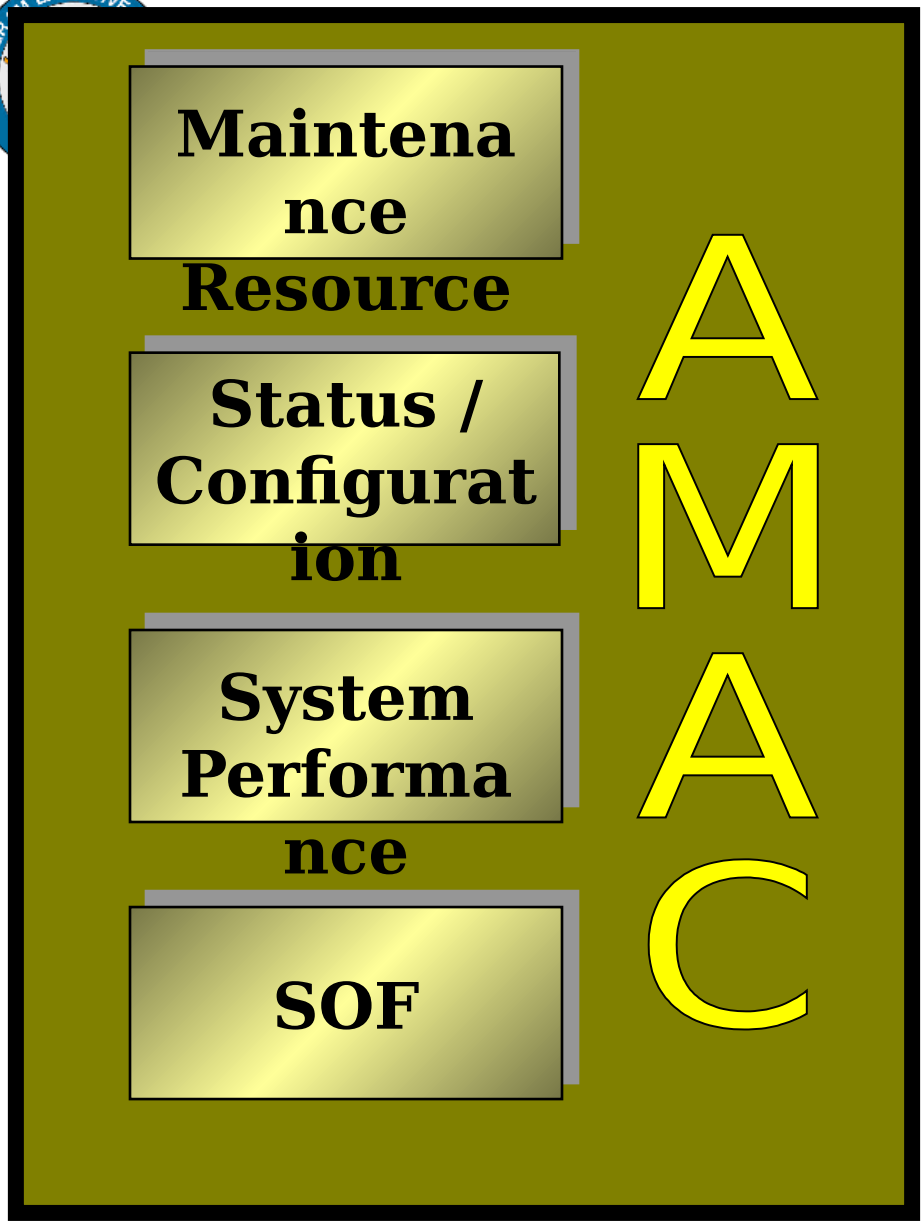
Steady increase in probability of failure

Low when new, then increases to steady failure rate

Random

Infant mortality, then random



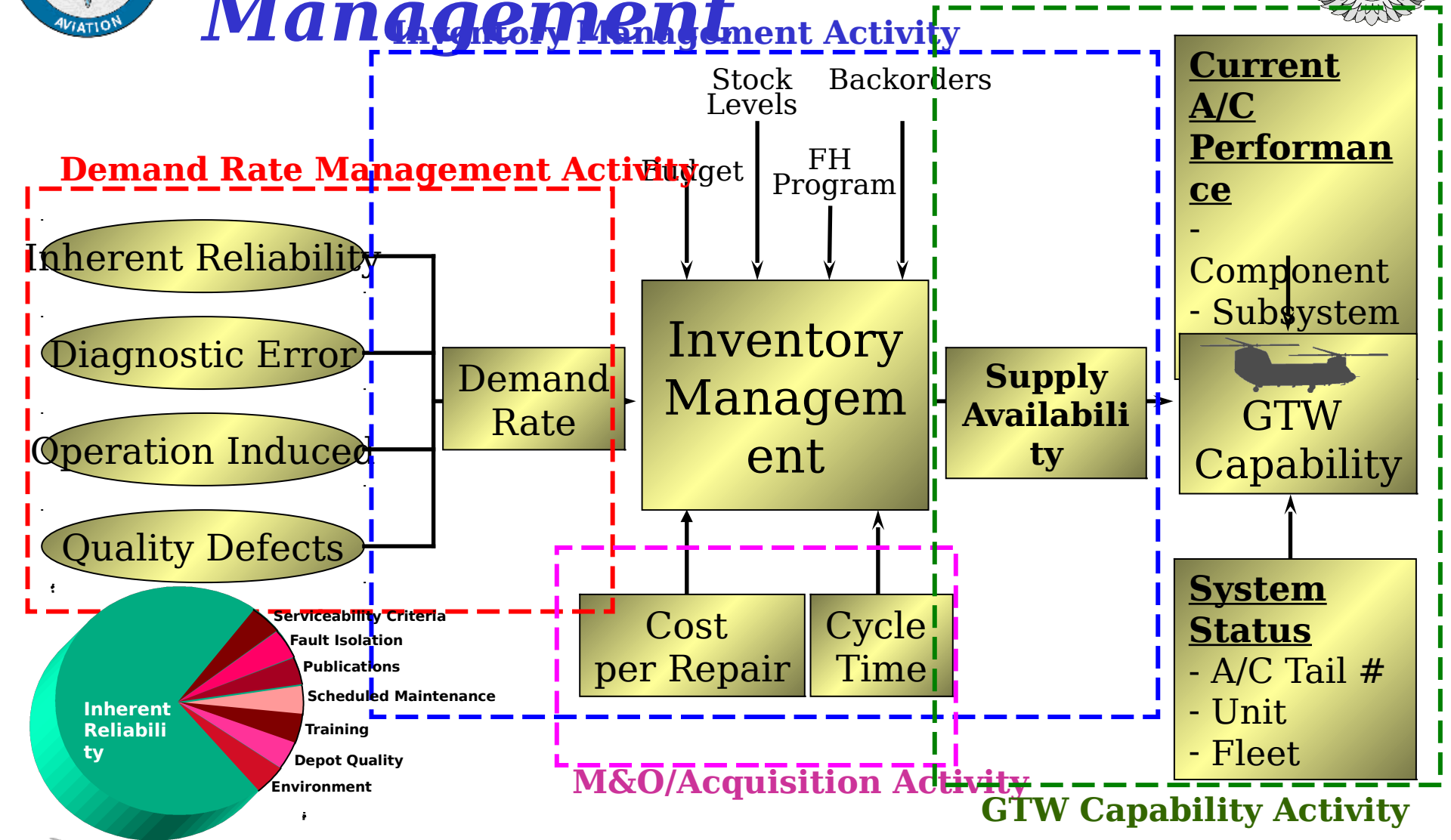


Operational Scenario

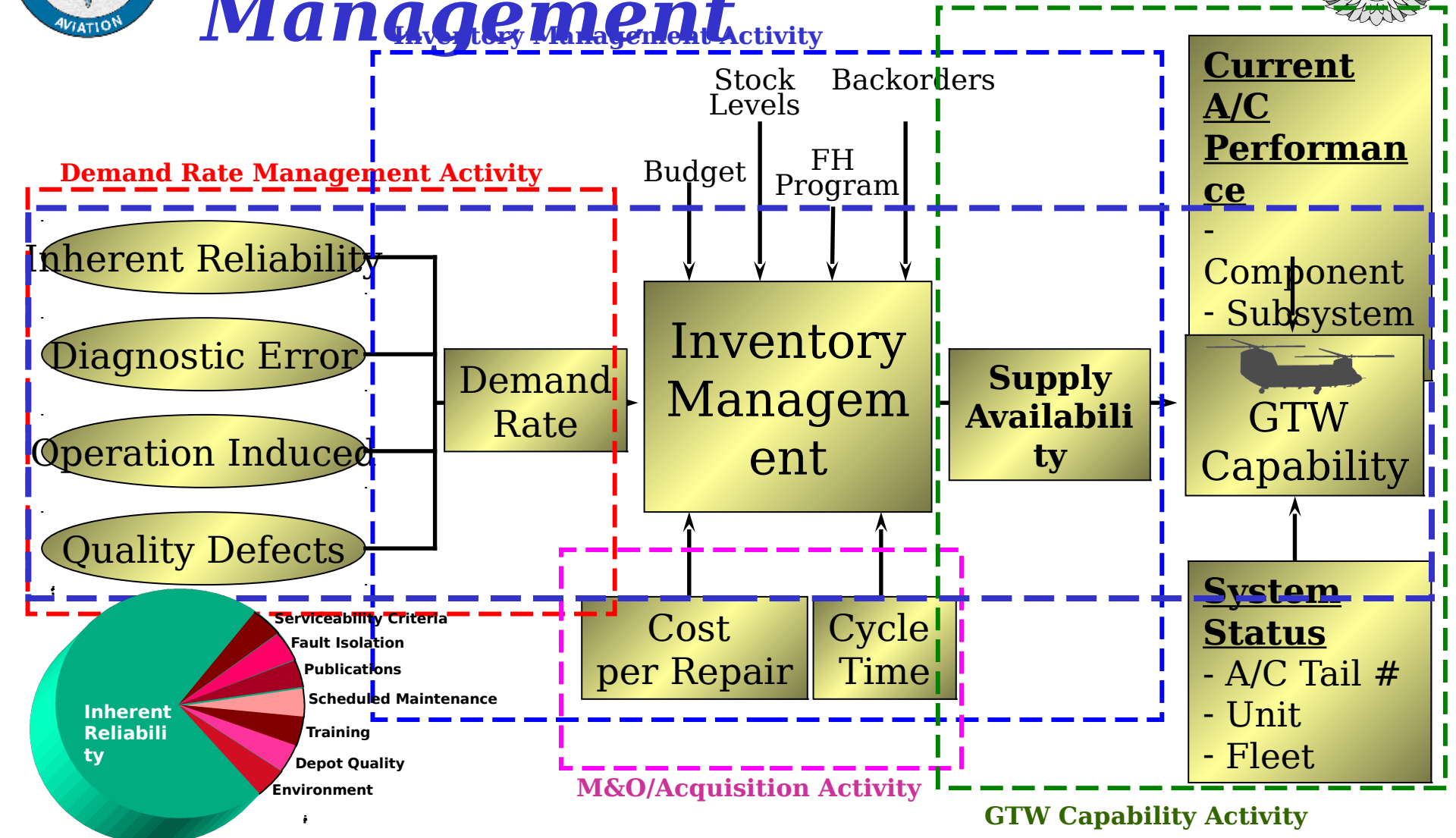
Go-to-War Capability Assessment

Supply Chain Information

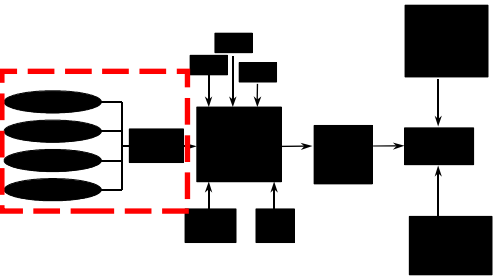
Focus: Inventory Management



Focus: Inventory Management



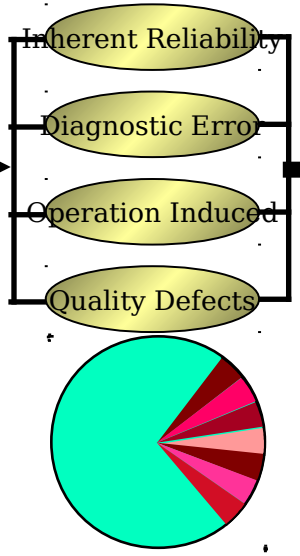
Demand Rate Management Activity



AMAC Field Data

- Data Analysis
- Data Mining
- Metrics

RCM2 Team Analysis



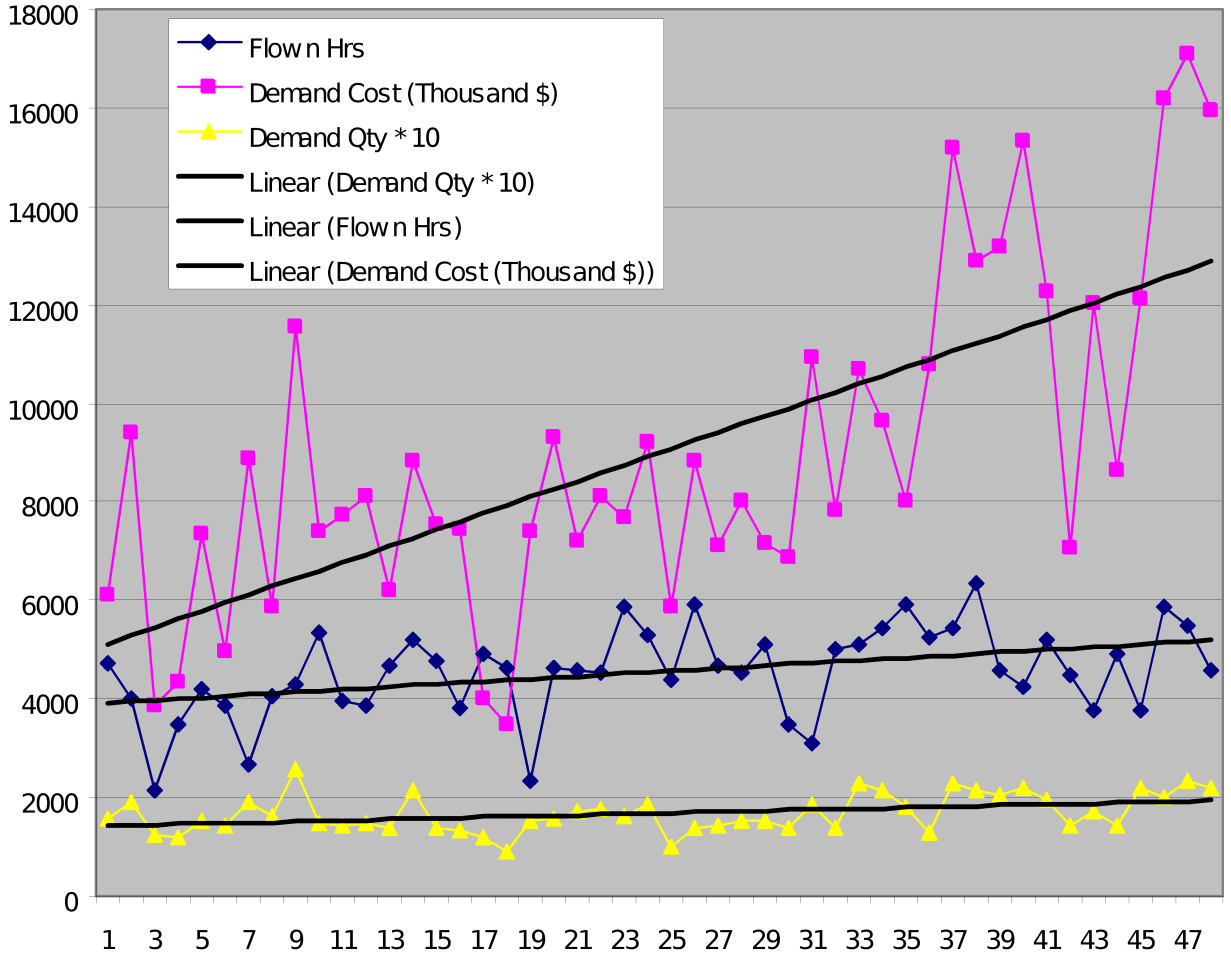
Demand Rate Reduction Opportunities

DTLOMS

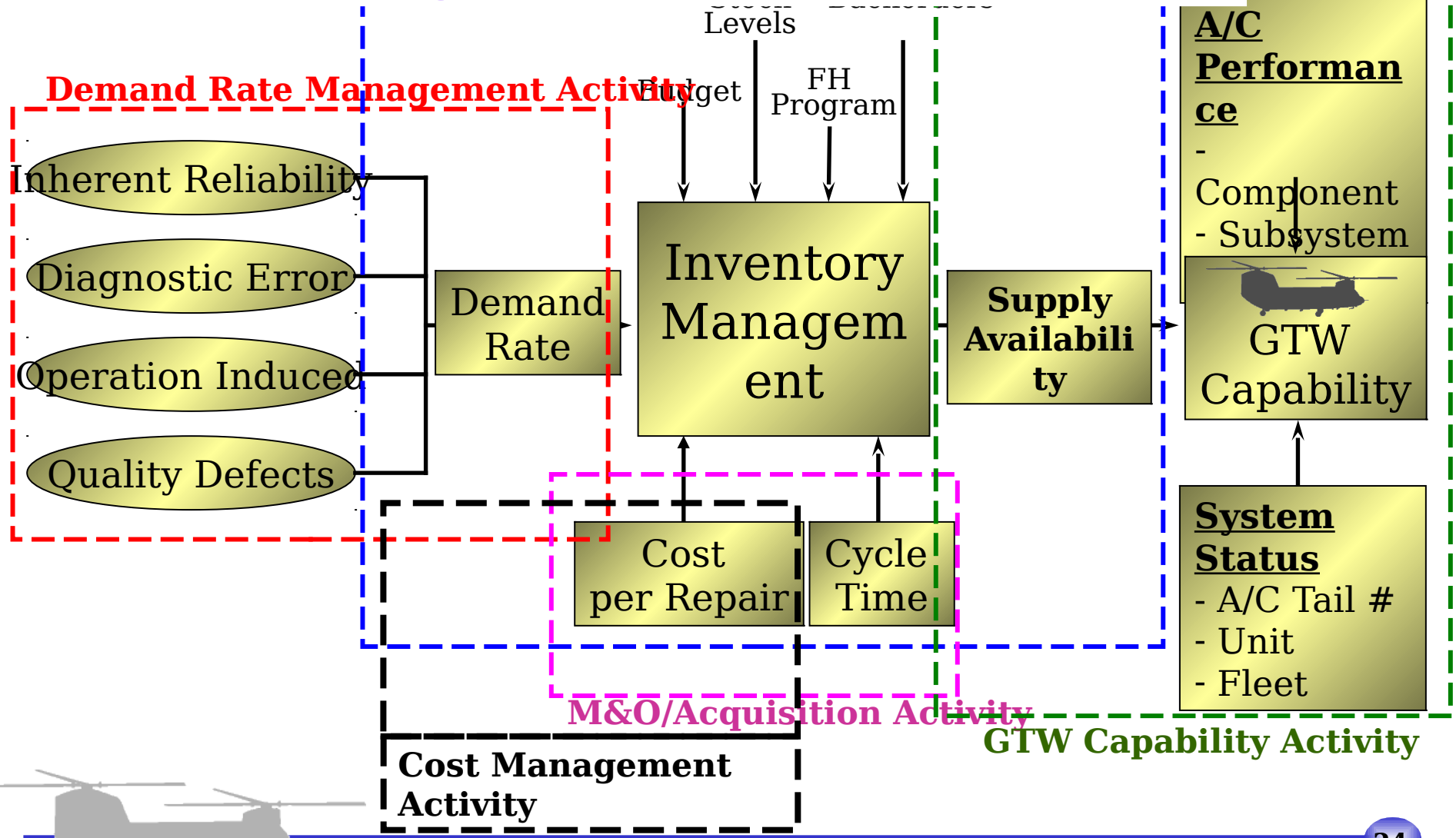
AMAC Depot Data

Sample of Cost of Operation Growth over 4 years

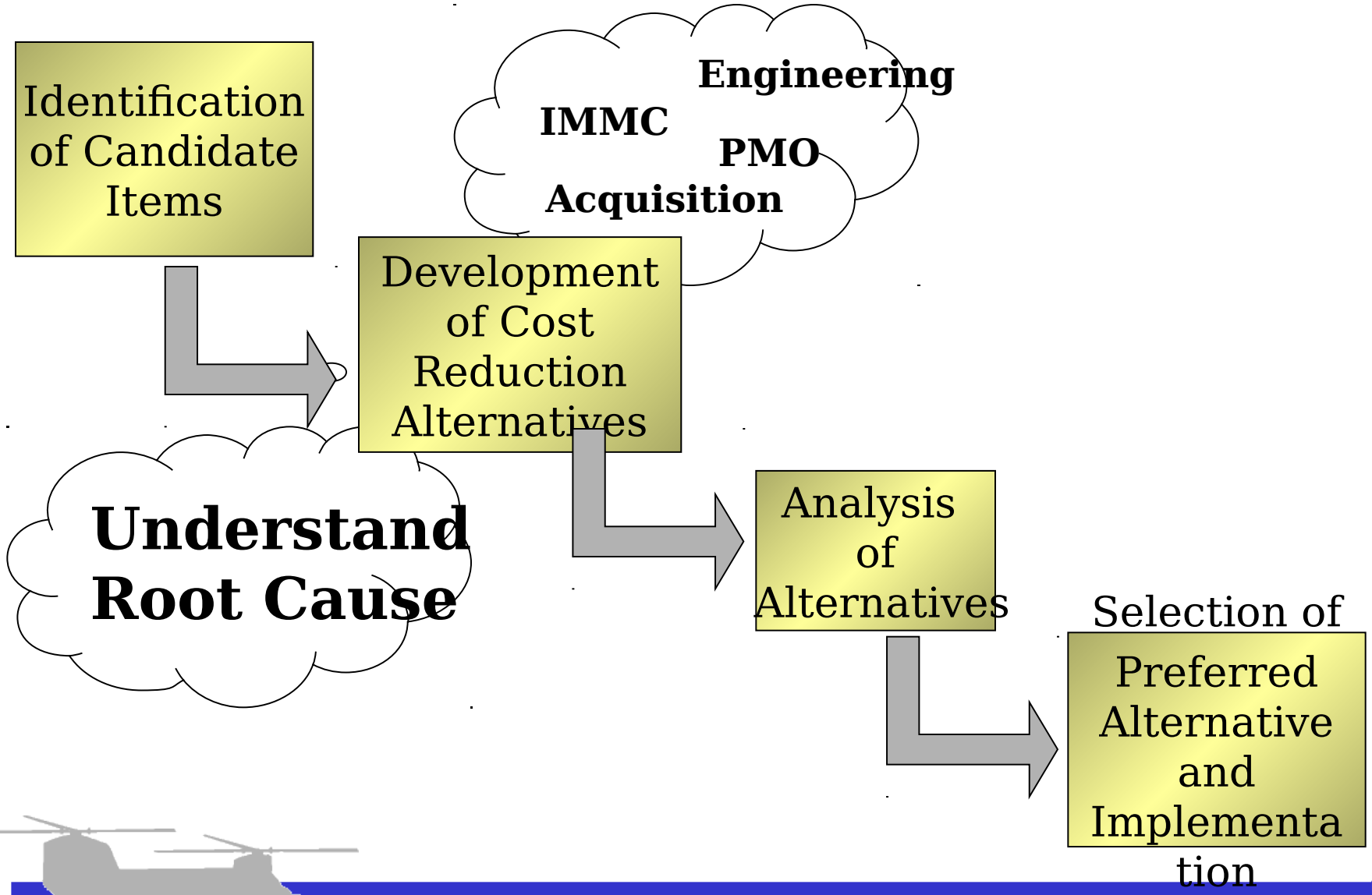
(7/99-6/03)



Focus: Cost Management



Cost Management Activity



O&S Cost Reduction

$$\text{Cost} = \sum \left(\text{Maint Event} * \text{ Co} \right.$$

Soldier Focused Logistics
Phase 2 - Organic PBL

- Organic PBL that works within Basic Army Infrastructure (Supply, Finance, Repair, Support).
- Establish Performance Based Agreements.
- Demonstration on a Single Subsystem.

Performance-Based Logistics

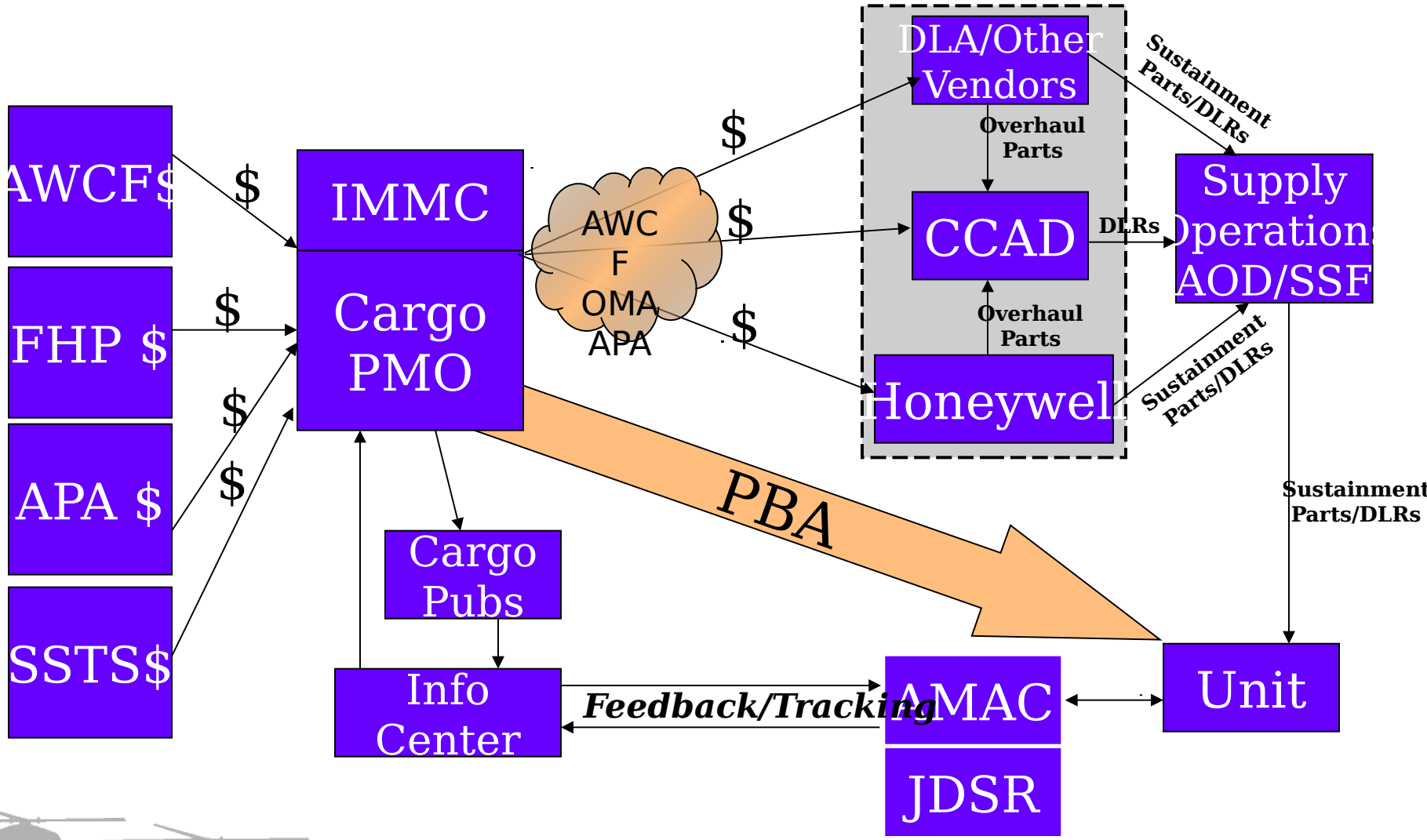
A strategy for weapon system product support that employs the purchase of support as an integrated performance package designed to optimize system readiness. It meets performance goals for a weapon system through a support structure based on performance agreements with clear lines of authority and responsibility.

SFL Pilot – T55-GA-714A Engine

- High cost driver
- Small initial population
  - 400 engines fielded by end of FY 03.
  - Target population of 1100.
  - Approx $38 M/yr Spare & Repair parts.
- DMWR in process.
- Depot partnership in work.
- Parts catalog contract in place.
- Willing contractors/DLA.
- Significant commercial equivalent base w/AIT.

14 Engine is a Low Risk Pil

Engine SFL Model



The Significance of RCM2

Agenda

- RCM Process
- Systems Analyzed
- RCM Results and Benefits
- Summary

The Traditional View of Failu

1955: Commercial Airline Industry

- 85% aircraft components scheduled for overhaul or replacement

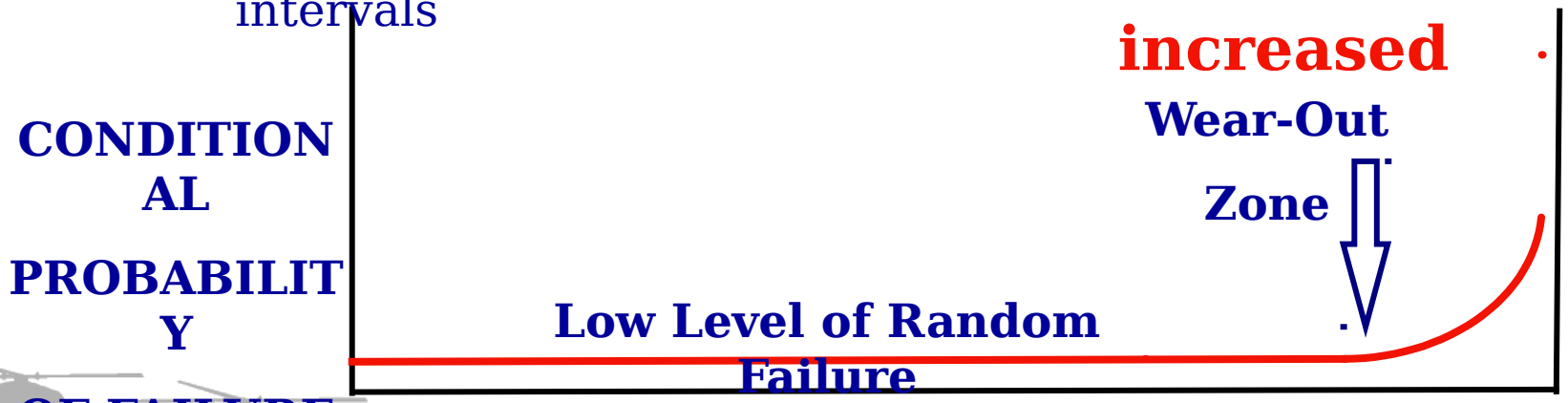
Early 1960s: Crash rate ~ 60 crashes/million takeoffs

- 67% of crashes due to component failure

The action taken to decrease crash-rate:

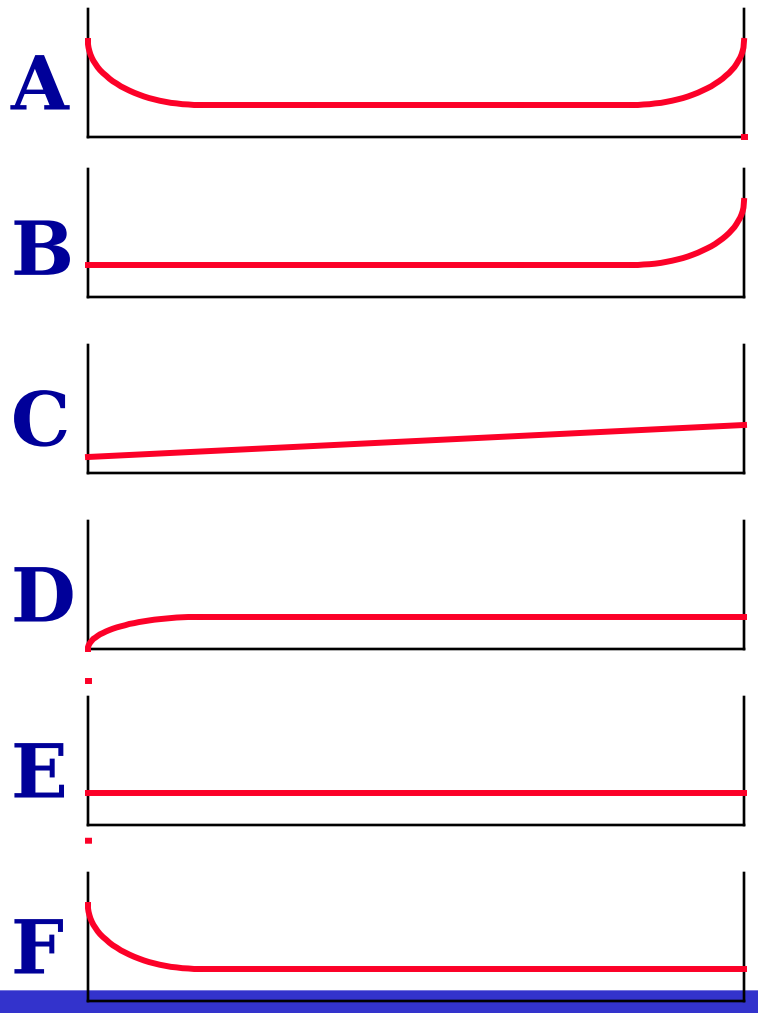
- Reduced overhaul/replacement intervals

→ Crash rate increased



Six Patterns of Failure

Stanley Nowlan and Howard Heap: Engineers, United Airlines



Bath Tub curve

Slowly increasing failure rate, then wear out zone

Steady increase in probability of failure

Low when new, then increases to steady failure rate

Random

Infant mortality, then random

4%

2%

5%

Simple or complex items that have direct contact with product. Ex. Tires, Brake Pads, Pumps

7%

14%

68%

Complex equipment. Ex. Electronics, Hydraulics, Pneumatics

Reliability Centered Maintenance 2

A process used to ensure that any physical asset continues to do whatever its users want it to do.

RCM2 Process

To Develop Justified Maintenance Requirements, the RCM Review Group Answers Seven Questions:

1. **What are its functions and associated performance standards?**
2. **In what ways can it fail?**
3. **What causes it to fail?**
4. **What happens when it fails?**
5. **Does it matter if it fails?**
6. **What can be done to predict or prevent each failure?**

RCM2 Process

1. **What are its functions and associated performance standards?**
2. **In what ways can it fai**
3. **What causes it to fail?**
4. **What happens when it fails?**

Questions 1-4: FMEA
(Failure Modes Effects Analysi

5. Does it matter if it fails?
6. What can be done to predict or prevent each failure?
7. What do we do if we cannot prevent the failure?

RCM2 Process

5. **Does it matter if it fails?** ***Considers safety implications of each failure mode first.***

Question 5: CONSEQUENCE ASSESSMENT

- Hidden
- Operational
- Safety/Environmental
- Non-Operational

6. What can be done to predict or prevent each failure?
7. What do we do if we cannot prevent the failure?

RCM2 Process

6. What can be done to predict or prevent each failure?

Question 6: **PROACTIVE TASKS**

- Scheduled On-Condition Tasks } Predictive Maintena

Application of **Condition Based Maintenance (**

- TBO Items
- Retirement Life Items

} Preventive Maintenance

7. What do we do if we cannot prevent the failure?

RCM2 Process

7. What do we do if we cannot prevent the failure?

Question 7: DEFAULT ACTIONS IF AN APPROPRIATE PROACTIVE TASK CANNOT BE IDENTIFIED

- **Failure Finding Task**
  - Check if the item is in a failed state.
- **Redesign**
  - Physical equipment modification.
  - Change in Training, Supply, or Equipment Operating Procedure
  - Correction/update to Technical Publications.
- **No Scheduled Maintenance**

RCM Review Group

Tech Pubs

Engineer

Test Pilot

Depot Artisan

Flight Engineer

Equipment Manufacturer

Mechanic

Facilitator

Chinook Systems Completed

- Flight Control System
- -714A Engine/FADEC
- -714A IETM
- Advanced Flight Control System (AFCS)
- Flight Hydraulic System
- Power Train
- Engine Air Particle Separator (EAPS)
- Fuel System

Power of RCM

- **Reengineered Maintenance Schedule**
  Maintenance task is generated
  an identifiable and explicit

- **Simulation Updates**
- **Physical Redesigns**
- **Procedural Redesigns**
- **Training Redesigns**
- **Operational Redesigns**
- **Technical Publication Redesigns**

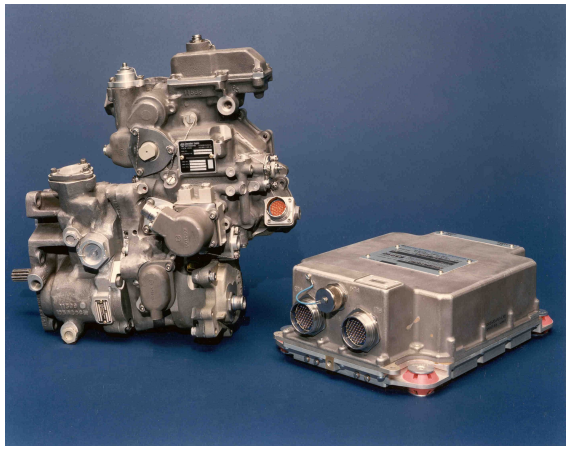
  ✯ RCM applied to the Interactive Electronic Technical Manual

- **Demand Rate RCM analysis to be performed**

CH-47D RCM2 Recommendations

SYSTEM	RECOMMENDATIONS					
	Physical	Publications	Training	Operational	Procedural	Simulator
-714A Engine	14	16	3	1	53	0
-714A FADEC	13	18	4	8	17	2
-714A IETM	1	20	0	0	0	0
Flight Control	5	16	2	0	36	0
Flight Hydraulics	2	1	0	2	19	0
Advanced Flight Control	6	0	0	1	10	0
Power Train System	8	1	0	1	27	0
EAPS	2	5	0	0	4	0
Fuel System	1	0	0	2	0	0
Total (321)	52	77	9	15	166	2
Implemented	12	15	7	5	13	2
In-progress	37	61	2	10	152	0
Disapproved	3	1	0	0	1	0

Results



- **Improved understanding of Full Authority Digital Electronic Control Unit (FADEC)**
  - ⇨ Developed an accurate and useable pilot fault code matrix
  - ⇨ Identified that simulator does not accurately replicate FADEC failures under certain conditions
- **Capitalized on -714A technology to increase readiness and reduce mission aborts**
  - ⇨ Established correct emergency and operating

Summary

"We're making a big difference here."

"...elevating weaknesses, errors, and deficiencies..."

"This is worth a zillion dollars if we can get this information out."

"It is a direct interface between us and the manufacturer."

"It gives the users a voice."

"I want to know why we aren't as good as we

Nancy Regan
ancyregan@theforceinc.com
617-921-5408